L Number	Hits	Search Text	DB	Time stamp
3	5	(monolithic adj optical adj component) and (optical near5 device)	USPAT; US-PGPUB	2004/12/08 11:36
4	1	(monolithic adj optical adj component) with substrate	USPAT; US-PGPUB	2004/12/08 11:34
5	15884	(lens or prism) with substrate	USPAT; US-PGPUB	2004/12/08 11:34
6	1731	((lens or prism) with substrate) and (optical adj device)	USPAT; US-PGPUB	2004/12/08 11:34
7	46	(((lens or prism) with substrate) and (optical adj device)) and (monolithic adj optical)	USPAT; US-PGPUB	2004/12/08 11:34
8	1	(monolithic adj optical adj component) same substrate	USPAT; US-PGPUB	2004/12/08 11:37
9	2	(monolithic adj optical adj component) and (substrate with optical)	USPAT; US-PGPUB	2004/12/08 11:38
10	76	(monolithic with optical with component) and (substrate with optical)	USPAT; US-PGPUB	2004/12/08 11:38
11	52	((monolithic with optical with component) and (substrate with optical)) and @ad<20010919	USPAT; US-PGPUB	2004/12/08 11:38

L Number	Hits	Search Text	DB	Time stamp
1	210	(three adj dimensional) and (lithographical$3 near3 defin$4) and @ad<20010919	USPAT; US-PGPUB	2004/12/08 08:27
2	1	(three adj dimensional) and (lithographical$3 near3 defin$4)	EPO; JPO; DERWENT; IBM_TDB	2004/12/08 08:19
3	4603	(three adj dimensional) and (photosensitive) and @ad<20010919	USPAT; US-PGPUB	2004/12/08 08:28
4	1563	(three adj dimensional) and (photosensitive adj (layer or film or material)) and @ad<20010919	USPAT; US-PGPUB	2004/12/08 08:37
5	1136	((three adj dimensional) and (photosensitive adj (layer or film or material)) and @ad<20010919) and optical	USPAT; US-PGPUB	2004/12/08 08:37
6	257	((three adj dimensional) and (photosensitive adj (layer or film or material)) and @ad<20010919) and (optical near5 device)	USPAT; US-PGPUB	2004/12/08 09:22
7	230	(three adj dimensional) and (photosensitive adj (layer or film or material))	EPO; JPO; DERWENT; IBM_TDB	2004/12/08 08:37
8	63	((three adj dimensional) and (photosensitive adj (layer or film or material))) and optical	EPO; JPO; DERWENT; IBM_TDB	2004/12/08 08:37
9	15	(((three adj dimensional) and (photosensitive adj (layer or film or material)) and @ad<20010919) and (optical near5 device)) and (optical adj coupler)	USPAT; US-PGPUB	2004/12/08 09:26
11	114	(photosensitive near3 (film or layer or material)) and (optical adj coupler)	USPAT; US-PGPUB	2004/12/08 09:27
12	8	(photosensitive near3 (film or layer or material)) same (optical adj coupler)	USPAT; US-PGPUB	2004/12/08 09:27

DOCUMENT-IDENTIFIER: US 20010016247 A1

TITLE: Laminate structure and method of manufacturing the same

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Abstract Paragraph - ABTX (1):

Disclosed is a method of manufacturing a laminate structure, comprising the steps of laminating a plurality of photosensitive material layers one upon the other to form a laminated photosensitive layer, the photosensitive characteristics of at least one of the photosensitive material layers differing from those of the other photosensitive material layers, applying a light exposure treatment to the laminated photosensitive layer a plurality of times under different light exposure conditions so as to transfer desired patterns to the plural photosensitive material layers, and developing the plural photosensitive material layers having the patterns transferred thereto.

Summary of Invention Paragraph - BSTX (4):

[0002] The present invention relates to a laminate structure and a method of manufacturing the same, particularly, to a laminate structure prepared by laminating photosensitive material layers and a method of manufacturing the same.

Summary of Invention Paragraph - BSTX (5):

[0003] It was difficult in the past to form a three dimensional laminate structure prepared by laminating a plurality of photosensitive material layers differing from each other in the pattern.

Summary of Invention Paragraph - BSTX (6):

[0004] For example, where coating and patterning are successively performed on each of photosensitive material layers, a lower side photosensitive material layer 101 formed on a substrate 100 is already patterned in the step of coating an upper side photosensitive material layer 102, as shown in FIG. 30, with the result that the upper side photosensitive material layer 102 is also formed in regions between adjacent patterns of the lower side photosensitive layer 101. It follows that it is impossible to form a desired three dimensional laminate structure.

Summary of Invention Paragraph - BSTX (7):

[0005] Also, where the light exposure is performed after lamination of a plurality of photosensitive material layers, all the photosensitive material layers 101 to 106 including the lowermost layer 101 and the uppermost layer 106 are similarly exposed to an exposure beam passing through a mask 120 so as to form a light exposure region 110. Therefore, it is impossible to make the photosensitive material layers different from each other in the pattern, resulting in failure to form a desired three dimensional laminate structure.

Summary of Invention Paragraph - BSTX (8):

[0006] Further, the manufacture of a three dimensional laminate structure requires the step of forming a pattern for each layer, making it impossible to form a desired three dimensional structure with a small number of manufacturing steps.

Summary of Invention Paragraph - BSTX (9):

[0007] As described above, it was very difficult in the past to obtain a three dimensional laminate structure prepared by laminating a plurality of photosensitive material layers differing from each other in the pattern.

Summary of Invention Paragraph - BSTX (12):

[0009] According to a first aspect of the present invention, there is provided a laminate structure prepared by laminating a plurality of photosensitive material layers having desired patterns, wherein a void (vacancy) is formed below an upper photosensitive material layer in a region where upper and lower photosensitive material layers adjacent to each other in the laminating direction do not overlap with each other.

Summary of Invention Paragraph - BSTX (13):

[0010] In the laminate structure of the present invention, it is desirable for at least one photosensitive material layer to differ from at least one of the other photosensitive material layers in the photosensitive characteristics and pattern. Also, in the laminate structure of the present invention, it is possible for a non-photosensitive material layer to be interposed between the patterns of the photosensitive material layers adjacent to each other in the laminating direction.

Summary of Invention Paragraph - BSTX (15):

[0012] laminating a plurality of photosensitive material layers one upon the other to form a laminated photosensitive layer, the photosensitive characteristics of at least one of the photosensitive material layers differing from those of the other photosensitive material layers;

Summary of Invention Paragraph - BSTX (16):
[0013] applying a light exposure treatment to the laminated photosensitive layer a plurality of times under different light exposure conditions so as to transfer desired patterns to the plural photosensitive material layers; and

Summary of Invention Paragraph - BSTX (17):
[0014] developing the plural photosensitive material layers having the patterns transferred thereto.

Summary of Invention Paragraph - BSTX (18):
[0015] In the method of the present invention for manufacturing a laminate structure, it is possible for the step of forming the laminated photosensitive layer to include the process of interposing a non-photosensitive material layer between the photosensitive material layers adjacent to each other in the laminating direction. Also, it is possible for the method of the present invention for manufacturing a laminate structure to include additional steps of loading a fluid in the clearance among the plural photosensitive material layers that have been patterned by the previous developing step, solidifying the fluid to form a solid material, and selectively removing the plural photosensitive material layers so as to leave the solidified material unremoved.

Summary of Invention Paragraph - BSTX (20):
[0017] repeatedly performing treatments to form at least one photosensitive material layer and to apply a light exposure treatment to the photosensitive material layer so as to transfer a desired pattern to the photosensitive material layer, thereby forming a laminated photosensitive layer consisting of

a plurality of photosensitive material layers having patters transferred thereto; and

Summary of Invention Paragraph - BSTX (21):

[0018] developing the plural photosensitive material layers having the patterns transferred thereto.

Summary of Invention Paragraph - BSTX (22):

[0019] In the method of the present invention for manufacturing a laminate structure, it is possible for the step of forming the laminated photosensitive layer to include the process of interposing a non-photosensitive material layer between the photosensitive material layers adjacent to each other in the laminating direction. Also, it is possible for the method of the present invention for manufacturing a laminate structure to include additional steps of loading a fluid in the clearance among the plural photosensitive material layers that have been patterned by the previous developing step, solidifying the fluid to form a solid material, and selectively removing the plural photosensitive material layers so as to leave the solidified material unremoved.

Summary of Invention Paragraph - BSTX (23):

[0020] In the present invention, a plurality of photosensitive material layers are formed and a light exposure treatment is applied to the photosensitive material layers, and finally, a developing treatment is applied to the plural photosensitive material layers. Therefore, the present invention is free from the problem inherent in the prior art. Specifically, in the present invention, in the step of coating the upper photosensitive material

layer, the upper photosensitive material layer is not formed in the region between adjacent patterns of the lower photosensitive material layer.
Therefore, it is possible to form a void (vacancy) below the upper photosensitive material layer in the portion where the patterns of the adjacent upper and lower photosensitive material layers do not overlap with each other.
It follows that it is possible to obtain a three dimensional laminate structure of a high accuracy having a desired shape.

Summary of Invention Paragraph - BSTX (24):

[0021] It is also possible to apply selectively a light exposure treatment and a developing treatment to each of the photosensitive material layers having different photosensitive characteristics by laminating the photosensitive material layers having different photosensitive characteristics and applying a light exposure treatment a plurality of times to these photosensitive material layers under different light exposure conditions. In this case, it is possible to apply collectively a light exposure treatment to these photosensitive material layers by periodically laminating a plurality of photosensitive material layers having the same photosensitive characteristics. It follows that it is possible to manufacture a three dimensional laminate structure having a periodic structure and having a very high positional accuracy with a small number of manufacturing steps.

Summary of Invention Paragraph - BSTX (25):

[0022] It should also be noted that, where the steps of forming a photosensitive material layer and applying a light exposure treatment to the photosensitive material layer are carried out repeatedly, followed by

developing the plural photosensitive material layers, it is possible to suppress the total attenuation amount of light, an electron beam, etc. within each of the photosensitive material layers. As a result, the light exposure treatment can be applied sufficiently to each photosensitive material layer without fail even in the case of laminating a large number of photosensitive material layers, making it possible to obtain a three dimensional laminate structure of a high accuracy.

Detail Description Paragraph - DETX (4):

[0057] FIG. 1 schematically shows a first example of the construction of a three dimensional laminate structure according to the present invention. In the example shown in FIG. 1, five patterned photosensitive material layers 11 and four patterned photosensitive material layers 12 are laminated one upon the other on a substrate 10 consisting of, for example, a semiconductor substrate. These five patterned photosensitive material layers 11 have the same photosensitive characteristics. Likewise, these four patterned photosensitive material layers 12 have the same photosensitive characteristics. On the other hand, the photosensitive material layers 11 differ from the photosensitive material layers 12 in the photosensitive characteristics.

Detail Description Paragraph - DETX (5):

[0058] In manufacturing the three dimensional structure shown in FIG. 1, the surface of the substrate 10 is alternately coated with the photosensitive material layers 11 and 12 to form a laminated photosensitive layer. Then, the laminated photosensitive layer is exposed to light under different light exposure conditions by using a mask for forming a pattern of the photosensitive

material layer 11 and another mask for forming a pattern of the photosensitive material layer 12, followed by a developing treatment, thereby obtaining the structure as shown in FIG. 1. In the light exposure step, light (visible light or ultraviolet light), an X-ray, an electron beam or an ion beam is used as the energy source.

Detail Description Paragraph - DETX (6):

[0059] Since all the photosensitive material layers 11 have the same photosensitive characteristics, it is possible to apply the light exposure treatment collectively to these photosensitive material layers simultaneously. Also, the photosensitive material layers 12 have the same photosensitive characteristics, making it possible to apply the light exposure treatment collectively to these photosensitive material layers 12 simultaneously. It should be noted that, since the photosensitive material layer 11 differs from the photosensitive material layer 12 in the photosensitive characteristics as described above, one of these photosensitive material layers is not allowed to respond to light during the light irradiating step of the other photosensitive material layer. It follows that it is possible to manufacture a three dimensional laminate structure having a periodic structure with a small number of manufacturing steps. It is also possible to obtain a very high pattern position accuracy among the photosensitive material layers having the same photosensitive characteristics.

Detail Description Paragraph - DETX (7):

[0060] It should also be noted that, since the light exposure and development are performed after the coating of the photosensitive layers 11 and

12, the photosensitive material layer on the upper side is not formed in regions between adjacent patterns of the photosensitive material layer on the lower side in the step of coating the upper side photosensitive material layer. It follows that a part of the photosensitive material layer on the upper side is formed not in contact with the photosensitive material layer on the lower side, making it possible to form a three dimensional laminate structure having a void (vacancy) region.

Detail Description Paragraph - DETX (8):

[0061] In order to prepare photosensitive material layers differing from each other in the photosensitive characteristics, it suffices to permit the photosensitive material layers to be different from each other in the sensitivity in accordance with the characteristics (kind, wavelength, etc.) of the energy source used for the light exposure such as light, an X-ray, an electron beam or an ion beam. In other words, the light exposure is applied to photosensitive material layers having different photosensitive characteristics under different light exposure conditions by using at least one of light, an X-ray, an electron beam and an ion beam as the energy source. For example, where the light exposure is applied to the photosensitive material layers 11 and 12 by using light, these photosensitive materials are made different from each other in the spectral response characteristics. It is also possible to permit the photosensitive material to exhibit different photosensitive characteristics depending on the kind of the energy source used for the light exposure. For example, the photosensitive material layer 11 is made of a material that responds to an ultraviolet light while using a material that

responds to an electron beam for forming the photosensitive material layer 12.
Incidentally, it is possible to permit the photosensitive material layers differing from each other in the photosensitive characteristics to be different from each other in the characteristics relative to at least one of the heat treatment after the light exposure and the developing treatment.

Detail Description Paragraph - DETX (10):
[0062] FIG. 2 schematically shows a second example of the construction of a three dimensional laminate structure of the present invention. In the example shown in FIG. 2, a plurality of patterned photosensitive material layers 21 to 24 are laminated one upon the other on a substrate 20 formed of, for example, a semiconductor substrate. The photosensitive material layers 21 and 22 are made of a positive type photosensitive material in which the light-exposed region is removed in the subsequent developing treatment. On the other hand, the photosensitive material layers 23 and 24 are made of a negative type photosensitive material in which the region that is not subjected to the light exposure is removed in the subsequent developing treatment. A plurality of the photosensitive material layers 21 have the same photosensitive characteristics.
A plurality of the photosensitive material layers 22 have the same photosensitive characteristics. A plurality of the photosensitive material layers 23 have the same photosensitive characteristics. Further, a plurality of the photosensitive material layers 24 have the same photosensitive characteristics. The positive photosensitive material layer 21 is substantially equal to the negative photosensitive material layer 23 in the photosensitive characteristics. Also, the positive

US-PAT-NO: 6343171

DOCUMENT-IDENTIFIER: US 6343171 B1
See image for Certificate of Correction

TITLE: Systems based on opto-electronic substrates with electrical and optical interconnections and methods for making

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Detailed Description Text - DETX (100):
The fabrication process may also be further modified to eliminate CMP polishing steps which may introduce optical scattering losses at key interfaces. When a **photosensitive material,** which is hardened by light exposure, is used to pattern the waveguides, CMP is not always necessary. After the step shown in FIG. 29, waveguide patterning can be carried out by light pattern exposure if the core layer is coated in an appropriate thickness of a photo-sensitive material, that is, close to or less than the OE device/material height excluding the top metal. Although the patterned waveguide may traverse a portion of the 45-degree-surface of the reflector, this will not significantly interfere with its function in reflecting the guided light. Additional planarization layers may be applied after the overcladding layer is formed, if necessary.

Detailed Description Text - DETX (150):
Referring to back FIG. 59, we now describe exemplary steps for constructing the structure shown in FIGS. 67-68. Starting with a base substrate 12, a first

cladding layer 21a is formed over the surface of base substrate 12, and cured. Cladding layer 21a may comprise any of the cladding materials previously described. Next, a second cladding 21b is formed over cladding layer 21a. This cladding layer can be any of the previously described cladding materials, including photosensitive cladding materials. Before cladding layer 21b is cured, a device chip 26 is adhered to it, such as was done in the previous construction methods. Layer 21b is then soft-baked to remove the solvent used to fluidize the polymeric cladding material. The results of these steps are shown in FIG. 60, which shows a cross-sectional view, and in FIG. 61, which shows a top plan view. If cladding layer 21b is not a **photosensitive material,** it is preferably cured at this point. (During these steps, appropriate electrode structures may be formed in the layers, as describe above; these steps are omitted here for the sake of brevity, but it will be apparent to one of ordinary skill in the art how these steps are incorporated given the previously-described construction methods).

Detailed Description Text - DETX (152):

If cladding layer 21b comprises a **photosensitive material,** then the pattern exposure of the photoresist layer could also pattern all of the portions of cladding layer 21b which are not under the whole chip 26, if a sufficiently long exposure is used. In this case, portions of cladding layer 21b would be removed in the development step of the photoresist layer. However, this is of no detrimental consequence. If one wishes, one can adjust the energy of the exposure step such that the photoresist layer is fully exposed but the cladding layer 21b is not fully exposed. One may also use portable conformal masking

structures to avoid exposure of cladding layer 21b at this point.

Detailed Description Text - DETX (154):

If cladding layer 21b does not comprise a **photosensitive material,** the unwanted portions of cladding layer 21b may be removed by plasma etching, using the individual chip as an etch mask, along with the photoresist patch above it, if so desired. In this case, any excess photoresist may be stripped away after the etch step. While the etch time can be controlled to only etch layer 21b, one can form a plasma-etch stop layer over layer 21a before layer 21b is formed, and can remove the plasma-etch stop layer after layer 21b has been defined by the plasma etch step. A chromium layer may be used for this purpose.

US-PAT-NO: 6252725

DOCUMENT-IDENTIFIER: US 6252725 B1

TITLE: Semiconductor micro epi-optical components

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Abstract Text - ABTX (1):

A method for fabricating a **monolithic** micro-**optical component**. The construction of the micro-optical components is accomplished by using standard semiconductor fabrication techniques. The method comprises the steps of depositing an etch stop layer (44) onto a semiconductor **substrate** (42); depositing an **optical component** layer (46) onto the etch stop layer (44); coating the entire surface of the **optical component** layer with a photoresist material; applying a photoresist mask (50) to the photoresist material on the **optical component** layer (46); selectively etching away the **optical component** layer (46) to form at least one **optical** column (52); forming a pedestal (54) for each of the **optical** columns (52) by selectively etching away the etch stop layer (44); and finally polishing each of the **optical** columns (52), thereby forming **monolithic optical** components (56). The method may optionally include the step of removing the photoresist mask from each of the optical columns prior to polishing the optical columns, as well as the step of depositing an antireflectivity coating onto each of the optical components.

Brief Summary Text - BSTX (8):

The present invention relates to a method for

fabricating monolithic
micro-optical components. The construction of the micro-optical components is
accomplished by using standard semiconductor fabrication techniques. The
method comprises, in one embodiment, the steps of depositing an etch stop layer
onto a semiconductor **substrate**; depositing an **optical component** layer onto the
etch stop layer; coating the entire surface of the **optical component** layer with
a photoresist material; applying a photoresist mask to the photoresist material
on the **optical component** layer; selectively etching away the **optical component**
layer to form at least one **optical** column; forming a pedestal for each of the
optical columns by selectively etching away the etch stop layer; and finally
polishing each of the **optical** columns, thereby forming **monolithic optical**
components. The method may optionally include the step of removing the
photoresist mask from each of the optical columns prior to polishing the
optical columns, as well as the step of depositing an antireflectivity coating
onto each of the optical components.

Detailed Description Text - DETX (3):

A micro-optical system 10 for use in an optical fiber network application is
depicted in FIG. 1. Micro-optical system 10 is a monolithic structure that is
created (as further described below) using standard semiconductor fabrication
techniques. Micro-**optical** system 10 includes an micro-**optical** component 14
connected by a pedestal 16 to a semiconductor **substrate** 12. The micro-optical
component 14 is shown as a spherical ball lens, but is intended to represent
various optical components, such as a cylindrical or conical lens, a concave or
convex lens, a prism or any other related optical devices. Each of these
components or combinations thereof serve to focus light or

redirect an optical
beam between other photonic components (e.g., receivers, transmitters and
repeaters) and may be used to construct a micro-optical system.

Detailed Description Text - DETX (7):

FIGS. 3-9 illustrate the steps for fabricating a micro-optical component of the present invention. FIG. 3 shows a side view of a typical semiconductor wafer 40. Commonly known epitaxy techniques (i.e., LPE, MOCVD, etc.) are used to grow precisely calibrated thin single-crystal semiconductor layers. An indium phosphide (InP) **substrate** 42 serves as a microbench for the micro-**optical** components. A pedestal layer 44 with a thickness on the order of 2-5 microns is deposited onto substrate 42. This layer is comprised of a ternary material (i.e. InGaAs or AlInAs) quaternary material (ie., InGaAsP) and determines the pedestal height for each optical component. Using the accuracy of the epi-crystal growth technology, the pedestal height can be controlled at the angstroms tolerance level. An optical component layer 46 is then deposited onto pedestal layer 44. Optical component layer 46 should be deposited at a thickness correlating to the maximum required lens dimensions (at least 20 microns thick). Indium phosphide (InP) is also chosen for optical component layer 46 because of its etching characteristics as well as its ability to form a high index lens with low aberrations.

Detailed Description Text - DETX (8):

In an alternative preferred embodiment, the **optical** component layer 46 and **substrate** 42 may be comprised of gallium arsenide (GaAs), whereas the pedestal layer 44 is comprised of aluminum gallium arsenide (AlGaAs). It is important

to note that other materials can be used for these various layers. For example, the **optical** component layer 46 and **substrate** 42 may be any III-V semiconductor material and may include indium phosphide (InP), gallium arsenide (GaAs), indium arsenide (InAs) and gallium phosphide (GaP). Moreover, although two different materials having similar thermal expansion coefficients may be used, the same material is preferably used for both **optical** component layer 46 and microbench **substrate** 42. In this way, optical alignment problems caused by thermal expansion are minimized in optical applications where wide temperature variations are common (i.e., in military and space applications).

Detailed Description Text - DETX (12):
Referring to FIG. 7, wet selective etching with controlled undercutting will provide a pedestal support or stem 54 for each of these optical columns. By using a selective (quaternary) etching solution, pedestal layer 44 is selectively removed from underneath the **optical** columns without effecting the binary or other material comprising the **optical** columns and **substrate** layer. Moreover, this undercutting etching approach provides sufficient space below each of the optical columns for polishing and subsequent formation of the optical components. Wet selective etching chemicals may include potassium hydroxide:potassium ferricyanide:deionized water (KOH:K.sub.3 Fe(CN).sub.6 :H.sub.2 O), lactic acid:nitric acid (10 CH.sub.3 CH.sub.2 OCOOH:HNO.sub.3), hydrochloric acid:nitric acid (HCl:n HNO.sub.3, where n>5), phosphoric acid:hydrogen peroxide:deionized water (H.sub.3 PO.sub.4 :H.sub.2 O.sub.2 :8H.sub.2 O), nitric acid (HNO.sub.3), sulfuric acid:hydrogen peroxide:deionized water (H.sub.2 SO.sub.4 :H.sub.2 O.sub.2

:H.sub.2 O), nitric
acid:tartaric acid:deionized water (n HNO.sub.3
:HOOC(CH.sub.2 O).sub.2
COOH:H.sub.2 O, where n between 1 and 10) and hydrofluoric
acid:hydrogen
peroxide:deionized water (HF:H.sub.2 O.sub.2 :n H.sub.2 O,
where n between 1
and 20).

Claims Text - CLTX (3):
an **optical** component being formed from an epitaxial
optical component layer
deposited on said **substrate**; and

Claims Text - CLTX (4):
a pedestal coupling said **optical** component to said
substrate being formed
from a stop etch layer, said stop etch layer being
interposed between said
optical component layer and said **substrate**.

Claims Text - CLTX (6):
3. The micro-**optical** system of claim 1 wherein said
optical components and
said **substrate** being comprised of material having
substantially similar thermal
expansion coefficients for improving **optical** alignment.

Claims Text - CLTX (7):
4. The micro-**optical** system of claim 1 wherein said
optical components
layer and said **substrate** being comprised of a material
selected from the group
consisting of indium phosphide (InP), gallium arsenide
(Gas), indium arsenide
(InAs) and gallium phosphide (GaP).